Int. J. Chem. Sci.: 14(4), 2016, 2367-2378
ISSN 0972-768X
www.sadgurupublications.com

PHYSICO-CHEMICAL ANALYSIS OF WATER OF JAIPUR CITY AND ITS DEFLUORIDATION BY USING BRICK POWDER AND MARBLE SLURRY POWDER: A GREEN APPROACH TO UTILIZE INDUSTRIAL WASTES

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ABSTRACT

'Green Chemistry' provides various tools and techniques including the ion-exchange, adsorption, reverse osmosis, precipitation and many more as some usual means of defluoridation. In present study, fluoride ion concentrations in water were determined spectrophotometrically at 570 nm by employing SPANDS method. Then Brick powder (BP) and marble slurry powder (MSP) were used as adsorbents in defluoridation of water. Use of these wastes as adsorbents serves two purposes at the same time, one is low cost and eco-friendly defluoridation and other one is waste management. Brick powder (BP) and marble slurry powder (MSP) are wastes found in brick kiln and marble industrial area situated nearby Jaipur City of Rajasthan state. The dose of adsorbents, contact time and concentration of fluoride ions will be discussed with their interdependence. For this study, water sample taken from different locations of Jaipur city were studied. It was found that the defluoridation capacity of brick powder is good than the marble slurry powder.

Key words: Fluoride, Brick powder, Marble slurry powder, Analysis of study.

INTRODUCTION

The studies of fluoride, a lot of efforts have been devoted and some new cost-effective fluoride adsorbents, such as, zeolites[1], natural adsorbent[2], low cost adsorbent[3] and biomass material, as well as other novel adsorbents[4] have been identified. The level of fluoride in the underground water of Newai region was exceeding the permissible limit (> 1.5 mg/L). It was found that about ten villages of Newai region was under serious fluoride contamination than bore well and hand pump water which causes adverse effect like

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dental and skeletal fluorosis[5]. It has been demonstrated that biosorption is good at affinity and selectivity for ion removal[6]. To find out the causes for the prevalence of Dental Fluorosis in Sanganer of Jaipur district and surface water had been collected from different villages of Sanganer[7]. The ground water forms a major source of drinking water in urban as well as in rural areas[8]. The effects of major parameters of adsorption like dose of adsorbent contact time and initial adsorbate concentration on fluoride removal efficiency were studied and optimization[9]. A systematic calculation of correlation coefficients among different physico-chemical parameters was also performed[10]. Phulera tehsil is facing the problem of groundwater pollution and determination of fluoride in ground water was conducted 40 villages of phulera tehsil[11]. The fluride in ground water was studied in Amber tehsil of Jaipur district in 25 villages were under surveillance[12].

A study of the water quality condition of Tonk district carried out to asses risk to human health and physico-chemical analysis of ground water sample[13]. The study focuses on the technique of defluoridation by using the method of electro-coagulation and ground water collected from Shivdaspura jaipur[14]. Waste water and ground water sample of Amanishah nallah in ganganer were studied to fined of the pollution load of generated from dyeing and printing units[15]. The study has been carried out to assess the ground water quality and its suitability for drinking purpose in most rural habitations of Bassi tehsil of Jaipur[16].

The study was carried out to adsorption method used of different types of adsorbents for defluorination and removal of other minerals, dyes and heavy metals e.g. burn clay[17], electrodialysis[18] and other low cost bioadsorbents like saw dust[19], used tea leaves, cow dung[20] have been found to be highly effective, cheap and eco-friendly. Fluorine is so highly reactive that it is never encountered in its elemental gaseous state except in some industrial process[21].

The fluoride forms many stable complexes with ammonium and iron. Other compounds, which exist in acid solution, are mono and hexa-fluoroaluminate; and mono and hexa-fluoroferrate. The simple free fluoride ion exists in alkaline solution[22].

Chronic ignition of fluoride rich fodder and water in endemic areas leads to development of Fluorosis in animal[23]. The entire spine code byossified with fluorosis[24]. The study has been carried out to assess the fluoride concentration in groundwater in some rural areas of Jaipur city (Rajasthan), India[25]. Due to increased population, urbanization, industrialization, use of fertilizers water is highly polluted with different harmful contaminants[26]. Defluoridation of drinking water is the only practicable option to overcome the problem of excessive fluoride in drinking water[27]. Low levels of fluoride are required for

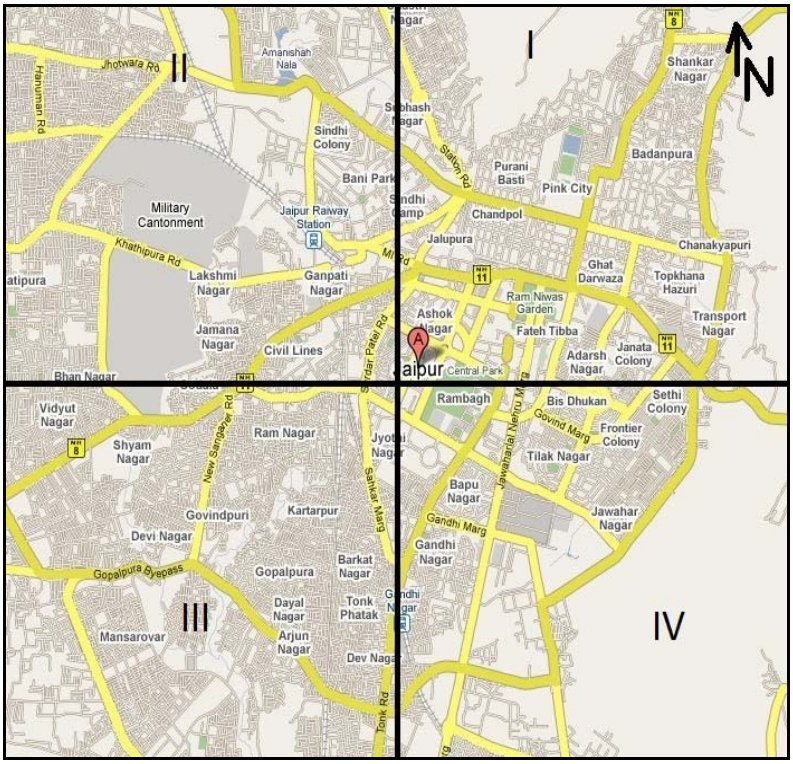
humans as it has beneficial effects on tooth and bone structures. However, ingestion of excessive fluorides, mainly through drinking water causes dental, skeletal and non skeletal fluorosis[28].

Geographical details of Rajasthan

Rajasthan is located in the north western part of the subcontinent. It is bounded on the west and northwest by Pakistan, on the north and northeast by the states of Punjab, Haryana, and Uttar Pradesh, on the east and southeast by the states of Uttar Pradesh and Madhya Pradesh, and on the southwest by the state of Gujarat.

Geographical details of Jaipur

Geographical area of Jaipur district is 11, 117.8 Km^2. Total numbers of villages is 2380. It is situated in the east of Rajasthan state. It is bounded by Sikar district on the North, Haryana state on the extreme northeast, Alwar and Dausa districts on the east, Sawai Madhopur district on the southeast, Tonk district on the south, Ajmer district on the west, and Nagaur district on the northwest. East and North area of Jaipur district is surrounded by Aravalli hills.



EXPERIMENTAL

Brick powder, utilized as an adsorbent was collected from a brick kiln, situated Jagatpura, Jaipur (India) and marble slurry powder collected from various marble industries situated nearly area of Jaipur city. Both of the adsorbents were washed several times with distilled water till clear water was obtained and dried in oven at 105ºC for 12 h. The dried material was sieved to obtain particles, of size less than 300 μm, for the present study.

General procedure

All studies were carried out in 250 mL conical flask with 100 mL test solution at room temperature. The adsorbent suspensions were equilibrated by shaking in horizontal shaker for different water sample and various control parameters like, adsorbent dose (2 g/100 mL), initial concentration of fluoride in samples, contact time (15 min) etc. At the end of the shaking period, the suspension were centrifuged and filtered using Whatmann filter paper No. 42 and residual fluoride concentration was determined in the super-natant liquid by SPADNS method. While effect of varius water sample were studied by dose and contact time, respectively. Optimum conditions were selected for further studies. Ground water samples collected from various sites of Jaipur city were studied for defluoridation. The physico-chemical properties of ground water samples were determined before batch study according to standard method of APHA[29].

RESULTS AND DISCUSSION

Comparison of fluoride before treatment and after treatment

The present studies on the effect of initial fluoride concentration are conducted by adsorbent dose of 2.0 g/100 mL, and contact time of 15 min. The maximum fluoride is in Agrawal and lowest is in Mahaveer Nagar-I. The fluoride concentration in water is determined before treatment and after treatment with brick powder and marble slurry powder. The brick powder is best of marble slurry powder because the removals of fluoride capacity are best of the marble slurry powder. It is further suggested that some kind of treatment for fluoride removal is immediately required in Jaipur city to avoid waterborne health problems.

Comparison of electro conductivity (EC) before treatment and after treatment

Electro conductivity is conducted by electro conductivity meter. Electro conductivity depends on TDS present in ground water sample. Electroconductivity of water is measured before and after treatment with brick powder and marble slurry powder. It is found that eletroconductivity of water decreased on treatment with brick powder and increased on treatment with marble slurry powder.

Table 1: Physico-chemical characteristics of ground water samples before treatment and after treatment with Brick powder (BP) and Marble slurry powder (MSP)

S. No.	Name of location	pH			EC			TDS		
		Before Treat.	After Treat. (BP)	After Treat. (MSP)	Before Treat.	After Treat. (BP)	After Treat. (MSP)	Before Treat.	After Treat. (BP)	After Treat. (MSP)
1	Mahavir nagar-I	9.2	8.7	8.8	0.55	0.48	0.60	352	310	380
2	Mahavir nagar –II	9.1	8.6	8.9	0.50	0.45	0.53	322	300	340
3	Gurjar ki thadi	10.2	9.4	9.6	1.42	1.35	1.49	930	840	950
4	New Atish market	9.3	8.8	8.9	0.92	0.86	0.98	590	530	610
5	Barkat nagar	8.5	8.0	8.2	0.81	0.74	0.86	520	480	550
6	Agrawal farm	9.4	8.6	8.8	0.94	0.83	0.98	616	541	626
7	Gopalpura main	9.2	8.6	8.9	0.43	0.40	0.46	276	250	305
8	Durgapura Main	10.2	9.3	9.7	0.56	0.50	0.59	364	330	380
9	Jyoti nagar	8.6	8.0	8.4	0.82	0.78	0.85	582	490	595
10	Vashundra nagar	8.9	8.3	8.6	0.53	0.45	0.56	338	305	350
11	Tonk Phatak	8.6	8.0	8.4	0.66	0.57	0.68	433	360	450
12	Vidhan sabba	9.5	8.9	9.1	0.62	0.56	0.64	396	330	410
13	Triveni nagar	8.5	8.1	8.4	0.43	0.39	0.46	280	210	305
14	Mansarover	8.6	8.2	8.4	0.98	0.91	1.00	627	540	650
15	Sanganer	8.8	8.5	8.7	0.37	0.34	0.40	243	190	270

Cont…

S. No.	Name of location	Tatol Alkalinity			Total Hardness			Chloride ion			Fluoride ion		
		Before Treat.	After Treat. (BP)	After Treat. (MSP)	Before Treat.	After Treat. (BP)	After Treat. (MSP)	Before Treat.	After Treat. (BP)	After Treat. (MSP)	Before Treat.	After Treat. (BP)	After Treat. (MSP)
1	Mahavir nagar-I	150	130	135	105	100	110	200	160	130	0.261	0.136	0.179
2	Mahavir nagar –II	125	115	120	80	75	85	100	90	80	0.343	0.286	0.305
3	Gurjar ki thadi	325	300	310	175	170	180	340	290	240	0.475	0.364	0.389
4	New Atish market	165	140	150	100	95	105	300	280	230	0.265	0.192	0.198
5	Barkat nagar	85	60	75	55	50	60	400	370	330	0.682	0.463	0.565
6	Agrawal farm	180	170	175	105	100	110	250	220	180	1.238	1.08	1.145
7	Gopalpura main	135	115	125	85	80	90	100	90	80	0.467	0.355	0.396
8	Durgapura Main	328	310	320	175	170	180	60	55	50	0.329	0.226	0.298
9	Jyoti nagar	90	70	80	55	50	60	210	180	170	0.485	0.356	0.398
10	Vashundra nagar	110	100	105	90	85	95	130	120	110	0.796	0.575	0.612
11	Tonk Phatak	100	85	95	100	95	105	150	140	120	0.668	0.452	0.531
12	Vidhan sabba	190	175	183	45	40	50	130	120	110	0.578	0.455	0.495
13	Triveni nagar	90	70	75	55	50	60	100	90	80	0.465	0.261	0.310
14	Mansarover	100	90	95	90	85	95	220	200	170	0.369	0.165	0.213
15	Sanganer	110	95	100	60	55	65	70	65	60	0.289	0.132	0.220

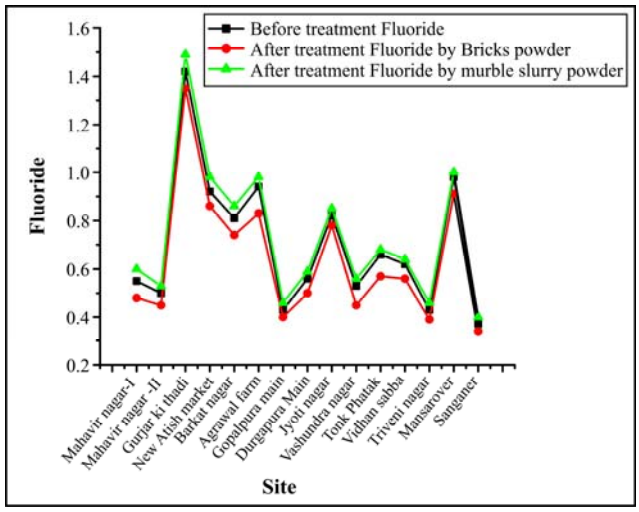


Fig. 1: Comparison of fluoride present before treatment and after treatment with brick powder & marble slurry powder

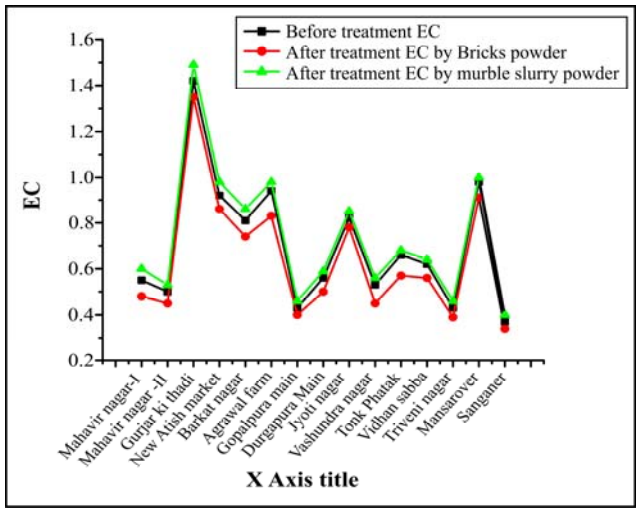


Fig. 2: Comparison of electric conductivity (EC) before treatment and after treatment with brick powder & marble slurry powder

Comparison of total dissolve solid (TDS) present before treatment and after treatment

TDS is maximum in Gurjar ki thadi and lower level is main Sanganer. Studies on the effect of total dissolve solid (TDS) concentration are conducted by adsorbent dose of 2.0 g/100 mL, and contact time of 15 min. TDS is comparison of before treatment and after

treatment are decreased of TDS concentration of ground water by used of bricks powder and increased by marble slurry powder.

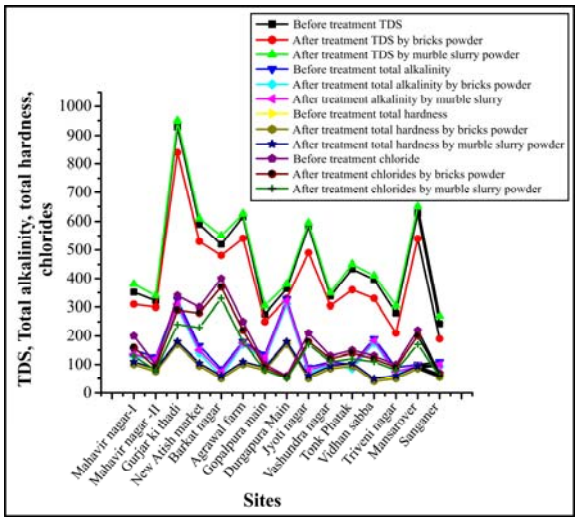


Fig. 3: Comparison of total alkalinity, total hardness, chlorides and (TDS) present before treatment and after treatment with Brick Powder & marble slurry powder

Comparison of total alkalinity before treatment and after treatment

Effect of total alkalinity concentration are conducted by adsorbent dose of 2.0 g/100 mL, and contact time of 15 min. The alkalinity is maximum of main Gopalpura site and lower level is Barkat nagar site. The alkalinity calculates by titration method. It is decreased in ground water by use of bricks powder and marble slurry powder. The brick powder is best of marble slurry powder because the removals of alkalinity capacity are best of the marble slurry powder. The total alkalinity was higher than the acceptable limit (200 mg/L).

Comparison of total hardness before treatment and after treatment

On the basis of physic-chemical analysis studied of water sources in Jaipur city (India), it has been concluded that the groundwater and dug well water quality varied spatially. Hardness was major health related issues. Total hardness of water decreases on treatment with brick powder and marble slurry powder.

Comparison of chloride before treatment and after treatment

Adsorbent dose of brick powder and marble slurry powder (2.0 g/100 mL), and

contact time of 15 min are taken for study. The studies of chloride ion is compared for before and after treatment. Concentration of chloride ion is determined after treating it with brick powder and marble slurry powder. It is further suggested that some kind of treatment for chloride removal is immediately required to avoid waterborne health problems in residents of Jaipur city. The maximum chloride ions are present in Barkat nager site.

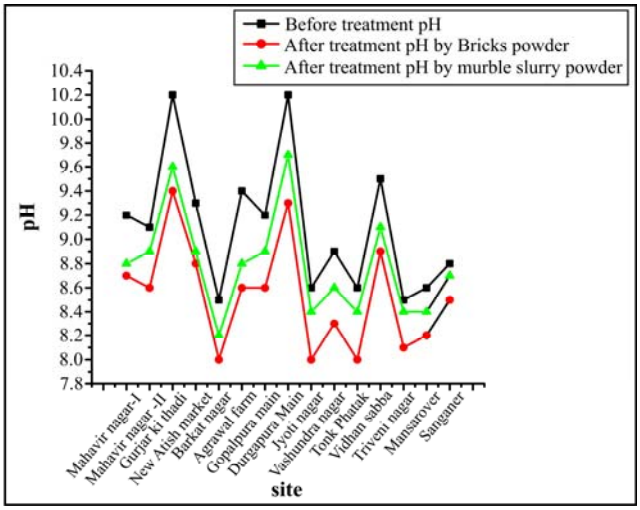


Fig. 4: Comparison of pH before treatment and after treatment with Brick Powder & marble slurry powder

Comparison of pH of the solution before treatment and after treatment

On the basis of physic-chemical analysis studies of water sources in Jaipur city (India), it has been concluded that the groundwater and dug well water quality varied spatially. The pH is maximum in Durgapura site and lower of Tonk Pathak site. Adsorbent dose of 2.0 g/100 mL, and contact time of 15 min was taken for study. Before treatment and after treatment pH is decreased in ground water by use of bricks powder and marble slurry powder. It is further suggested that some kind of treatment for pH is immediately required to avoid waterborne health problems in residents of Jaipur city.

Based on these studies, it is concluded that activated bricks powder can be utilized for the removal of fluoride. The fluoride removal are found to be a function of adsorbent dose and contact time at a given initial solute concentration. The removal increased with adsorbent dose, but with higher initial solute concentration decreased with adsorbent dose.

CONCLUSION

In the present study, brick powder and marble slurry powder were used as adsorbents for removal of fluoride from synthetic as well as from various ground water samples of different fluoride concentrations. The maximum fluoride is present in Tabba bala Jagatpura and lower level of fluoride is Sanganer sites. Fluorides are measured by SPANDS method. The main conclusions that can be drawn from the above study are given as: adsorption of fluoride on brick powder and marble slurry powder, defluoridation capacity of brick powder is good than the marble slurry powder. Both the Langmuir and Freundlich adsorption isotherms fitted well for the fluoride adsorption on bricks powder with the regression coefficient of 0.99 and 0.98, respectively. It can both be regenerated thermally and chemically. Bricks proved effective for the treatment of fluoride contaminated actual drinking water samples. It can be explained on the basis of the chemical interaction of fluoride with the metal oxides, which makes it very suitable for use in ground water treatment. Presence of others ions in groundwater did not significantly affect the defluoridation process thereby indicating that brick powder and marble slurry powder are selective adsorbent for fluoride. High concentration of fluoride may also cause harm to the ecosystem and vegetation, if used for irrigation.

ACKNOWLEDGEMENT

Author (NK) thankfully acknowledge the scholarship given by President, JECRC University for his Ph.D. work.

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Revised : 26.08.2016 *Accepted : 28.08.2016*